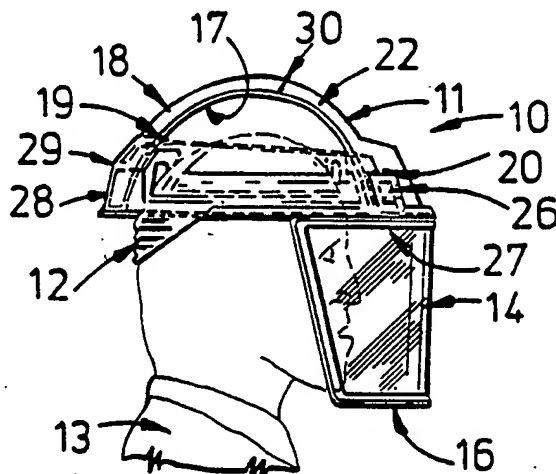




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(21) International Application Number: PCT/GB93/01616 (22) International Filing Date: 30 July 1993 (30.07.93) (30) Priority data: 9216316.1 31 July 1992 (31.07.92) GB 9303666.3 5 April 1993 (05.04.93) GB (71) Applicant (for all designated States except US): MINE SAFETY APPLIANCES COMPANY LIMITED [GB/GB]; 9 Albury Close, Loverock Road, Reading, Berkshire RG3 1BD (GB). (72) Inventor; and (75) Inventor/Applicant (for US only): MURPHY, Terence, Walter, Daniel, Respair [GB/GB]; Wilson House, 74-76 Wilson Gardens, Harrow, Middlesex HA1 4QA (GB).		(74) Agents: McCALLUM, William, Potter et al.; Cruikshank & Fairweather, 19 Royal Exchange Sq., Glasgow G1 3AE (GB). (81) Designated States: AT, AU, BB, BG, BR, BY, CA, CH, CZ, DE, DK, ES, FI, GB, HU, JP, KP, KR, KZ, LK, LU, MG, MN, MW, NL, NO, NZ, PL, PT, RO, RU, SD, SE, SK, UA, US, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>

(54) Title: HELMET RESPIRATOR APPARATUS**(57) Abstract**

Respirator apparatus (10) comprises a monocoque helmet (11), with a visor (14), which is pivotal between an inoperative raised position and an operative lowered position. The helmet (11) is formed of outer shells (17, 18) joined together along the rim and at strategic locations within the domed area of the helmet but are selectively spaced apart in various regions to provide an air chamber (19), at the rear of the helmet (11) and an air chamber (20) at the forward part of the helmet. These chambers (19, 20) are interconnected by three ducts (21, 22, 23). The chamber (19), opens through the outer shell and is fitted with an air filter (25), to receive incoming air. The chamber (20) opens through the inner shell (17) and is fitted with a fan (26) to propel air through the ducts (21, 22, 23) into a breathing zone formed behind the visor (14). The rear portion of the helmet is provided with a chamber (29) which is isolated from the ducts (21, 22, 23) and which accommodates batteries for energising the fan (26). The visor (14) may be arranged to activate the fan automatically when it is moved to its lowered position.

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HELMET RESPIRATOR APPARATUS

FIELD OF THE INVENTION

This invention relates to helmet respirator apparatus which provides protection for the head, face and eyes of a user and delivers filtered air for the user to breathe to protect the user from atmospheres contaminated with dusts, fumes, gases and vapours that are hazardous to health.

BACKGROUND ART

Many forms of respirator apparatus of this type have been proposed and marketed but certain of these are of such a construction that the amount of head protection is less than that which can be provided with a conventional and non-respirated hard hat, and the level of respiratory protection provided in some of these devices is also limited to the lower order of respiratory hazards. There are statutory health and safety regulations in some countries that identify and set standards for protective helmets and respiratory devices. Some examples of these known devices are disclosed in patent specifications - Howie GB 2,201,601,A - Scott GB 2,227,158 and Berg/Kvaal PCT/US81/00244 - Vaughan/Wiggins PCT/US82/01154 - Gorman U.S. Patent 4,136,688 - Schoelz/Tidland U.S. Patent 3,649,946, Chien U.S. Patent 4,549,541 - Depping U.S. Patent 3,413,972 - Guy U.S. Patent 3,822,698 - Grenough G.B. Patent 1,426,432, U.K. Patent 1,426,432, - 1,495,020 - European Patent 0047296, U.S. Patent 3,258,010 - 3,649,964 and 3,822,698.

Examples of devices presently manufactured are the Airstream and Jupiter helmets manufactured by Racal Ltd.; The PF2 and PF3 Helmets manufactured by Pureflo Ltd., and the Clearflow Turbovisor manufactured by Pulsafe Ltd. All of these devices have features that make them

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difficult, awkward or cumbersome to use.

OBJECT OF THE INVENTION

It is an object of the present invention to provide a new and improved form of helmet respirator apparatus which is easy to use and is of lightweight construction. Other objects and advantages of the present invention will be apparent from the ensuing description of preferred embodiments.

SUMMARY OF THE INVENTION

According to the present invention there is provided respirator apparatus comprising a helmet having a pivotally mounted face shield fitted to the front of the helmet (in the wearing position), the face shield carrying on its edge a flexible sealing member adapted when the face shield is in its lowered or operational position to seal at its lateral edges with the face of a person wearing the helmet, the lower edge of the sealing member defining an exhalate outlet, wherein the helmet comprises a plurality of lightweight shells joined together to form a unitised structure incorporating a plurality of ducts extending between the shells to channel a plurality of air flows from a filtered air intake arrangement in a rear portion of the helmet to an air outlet arrangement at the front of the helmet and behind the face shield, air being powered through the ducts by a motor driven fan forming part of the air outlet arrangement and located within the ducts, and batteries providing a power source for the fan are located within a compartment formed in the rear portion of the helmet and isolated from the ducts, the batteries and air filter being replaceably mounted in the rear portion of the helmet and releasable exteriorly therefrom via apertures formed in the outermost shell of

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the helmet.

It will be understood that the present invention is also concerned with a respirator apparatus as set forth in the immediately preceding paragraph wherein an air supply is led to the ducts via a hose from an external air source, in which case the helmet may not require to have the air filter and battery modules fitted. The fan may be fitted if so desired but rendered inoperable due to the absence of batteries.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a partly sectional side view of a first embodiment of respirator apparatus according to the present invention;

Fig. 2 is a top plan view of the respirator apparatus shown in Fig. 1 and is partially cut away and exploded to illustrate details;

Fig. 3 is a side elevation of the Fig. 1 respirator apparatus with a modified detail;

Figs. 4 and 5 are scrap views to illustrate further modified details;

Fig. 6 is a rear view of the Fig. 3 apparatus;

Fig. 7 is a rear view similar to Fig. 6 but showing further modifications;

Fig. 8 shows a disassembled part of the Fig. 1 apparatus;

Fig. 9 shows a modified form of the respirator apparatus;

Figs. 10A and 10B illustrate details of the Fig. 9 apparatus.

Fig. 11 is a view of the Fig. 9 apparatus taken from the rear;

Fig. 12 is a view of the Fig. 9 apparatus taken from above; and

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Fig. 13 and 14 illustrate alternative details of the Fig. 9 apparatus.

DETAILED DESCRIPTION

Referring to Figs. 1, 2 and 3 the first embodiment of respirator apparatus 10 comprises a helmet 11 incorporating a headband arrangement 12 to enable the helmet to be worn by a user 13. Helmet 11 carries a visor 14 which is pivotally mounted at 15 adjacent the rim of the helmet to enable the visor to be moved into and out of position. The peripheral edge of the visor 14 carries a face seal 16 which mates with the face of the user 13 when the visor 14 is in its lowered or operative position (Fig.1) and establishes a breathing zone for the user 13.

The helmet 11 is formed of inner and outer shells 17,18 which are joined together along the rim of the helmet and at strategic locations within the domed area of the helmet but are selectively spaced apart in various regions to provide an air chamber 19 located generally to the rear of the helmet 11 and an air chamber 20 generally to the forward part of the helmet and these chambers 19,20 are interconnected by three ducts 21,22,23.

Chamber 19 at the rear of the helmet 11 opens through the outer shell 18 to enable a supply of air to be delivered to the ducts 21,22,23 and in this embodiment the opening is formed as two separate apertures 24 disposed on either side of the longitudinal centre line of the helmet 11. Air filters 25 are fitted to the apertures 24 to filter air entering the ducts 21,22,23. Chamber 20 at the front of the helmet is large enough to accommodate a fan 26 to propel air through the ducts 21,22,23 and the chamber 20 opens via a grille 27 through the inner shell 17 into the breathing zone adjacent the wearer's face and behind the visor 14. The fan 26 is powered by batteries 28 which are housed in a compartment 29 formed by shaping

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the outer shell 18 at the rear of the helmet and centrally disposed. The compartment 29 is isolated from the ducts 21,22,23 and the batteries 28 are removably located in the compartment via an aperture formed in the outer shell 18. Exhalate from the breathing zone issues from the apparatus 10 via an aperture which may be valved in the lower portion of the visor 14.

The inner and outer shells 17,18 are preferably thermo-formed or moulded from a suitable resilient plastic material such as ABS, high impact polystyrene or polypropylene or polycarbonate and each would typically be about 0.5 mm thick over the domed part of the helmet 11 and up to 1.0 mm thick at the helmet rim. The shells 17,18 are generally profiled to define the ducts 21,22,23 which may have a cross-section of about 10 mm by 40 mm. If so desired only outer shell 18 may be contoured (as shown in Figs. 6, 7 and 12) with inner shell 17 being generally in the form of a smooth dome. The shells 17, 18 are individually flimsy but when bonded together around the rim and in the mating domed areas form a helmet 11 of monocoque construction which is of substantially greater strength than its constituent parts.

To provide the helmet 11 with improved impact properties to enhance the degree of mechanical protection provided to the wearer 13 either the outer shell 18 can be thickened or a third dome-like or intermediate shell 30 may be provided and located between shells 17 and 18 and bonded to at least one of these shells. The intermediate shell 30 may be constructed from a thicker and harder grade of plastic composite material or metal according to the amount of head protection required or may be formed by applying a coating of glass fibre reinforced resin or other suitable composite or plastic material to the appropriate surface of one of the shells 17,18. The outer shell 18 may be colour coded to indicate the level of protection provided by the helmet 11.

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The air filter 25 may take the form illustrated in Fig. 8 which comprises a sock or bag filter element 25A releasably mounted on a rigid holder 25B which incorporates the air inlet grille and is a releasable snap fit to the aperture 24 formed in the outer shell 18. Alternatively, as is illustrated in Fig. 5, the filter 25 may be in the form of a cartridge filter 25C which incorporates its own inlet grille moulding and is fitted to the outer shell 18. The use of a cartridge filter 25C requires a different shape of aperture in the outer shell 18 and this is illustrated in Fig. 3.

The fan 26 which is provided in chamber 20 may be an axial fan as illustrated in Fig. 1 or a centrifugal type fan as illustrated in Fig. 4. There is enough space to accommodate either a 60mm diameter axial fan or an 80mm diameter centrifugal fan.

The headband arrangement 12 may take any one of a number of different forms such as the conventional snap fastener arrangement 31 shown in Fig. 6 but where the visor 14 is of the type providing protection during a welding operation (shaded glass or liquid crystal shutter) it is desirable for the headband arrangement 12 to be fitted with a rack and pinion adjustment arrangement 32 as illustrated in Fig. 7. This enables operation of the visor 14 between its two positions (compare Figs. 1 and 3) to be by way of a nod down of the head of the user 13 provided that the headband arrangement effectively clamps the helmet 11 to the user's head. The adjustment arrangement 32 may require the helmet rim to be locally cut away which in turn requires slight repositioning of the battery compartment 29.

Fig. 9 shows a form of the respirator 10 in which visor 14 is pivotally mounted to helmet 11 by a modified form of pivot mechanism 35 which is camouflaged by a cover plate in Fig. 9 but is shown in detail in Figs. 10A and 10B and which is mounted on the helmet 11 above the rim.

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Mechanism 35 is provided to enable the visor to be a snug fit to the outline of the helmet 11 when the visor 14 is inoperative or in its up position as shown in Fig. 9. Thus, the Fig. 9 construction is more compact i.e. has a lower profile than the Fig. 3 construction which uses a simple pivot 15. Additionally, in Fig. 9 the air filter 25 is centrally located at the rear of the helmet 11 (so that there is only one aperture 24 in this embodiment) and the two battery compartments 29 are provided laterally of the central line, these details being more clearly shown in Figs. 11 and 12. The rear portion of the helmet 11 is square-cut as shown in Fig. 12 to accommodate the filter 25 which for example is of the pleated cartridge type.

Returning now to Figs. 10A and 10B which show the mechanism 35, this includes a plate 36 secured to the helmet 11 and having cam slots 42, 43, and a pivot plate 37 carrying the visor 14, and having two retaining locators 38, 39 which move in the slots 42, 43. The retaining locators 38, 39 are formed by small diameter bosses projecting from the pivot plate 37 and which are a sliding fit in the cam slots 42, 43. The bosses terminate in an enlarged head which is greater than the width of the slots 42, 43.

The smaller slot 43 is essentially parallel to the rim line of the helmet 11 whilst the larger slot 42 is angled at about 45° thereto. Thus, when the visor 14 is moved away from its down or operative position adjacent the face of the wearer, it initially pivots about a point on the centre axis of the locator 38. Thereafter, locator 39 moves in a forward direction along the slot 43 whilst the location 38 in slot 42 moves in a direction along and towards the lower end of that slot. Thus the visor 14 moves in a path which ensures that it does not come into contact with the edge of the helmet 11 and in the course of the movement of the locators in the slots, there comes a point in time when they are aligned perpendicularly to

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the slot 42 whereafter the movement of the locator 39 in slot 43 is reversed so that it moves towards its original position at the back of the slot, and finally movement of the visor ceases when the locator 38 reaches the lower end of slot 42.

A tension spring 40 is mounted between the smaller diameter of the retainer 39 and a mounting post 41 secured to the cam plate 36 and is arranged such that it is extended by approximately 10% of its total length, so that the visor 14 is held under spring pressure in either the up position or the down position. When the visor 14 is in the down position the spring tension pulls the retainer locator 39 towards the back end of slot 43 adjacent to the post 41. The visor 14 is thus held in a snap-like, toggle action in either of its two possible positions and conveniently activates a switch when in its lower operative position in order to energise the fan 26. The switch is preferably mounted at the rim of the helmet 11 and forms part of the fan assembly 26.

The motion of the pivot mechanism 35 in upward pivotal movement of visor 14 is arranged to terminate to prevent the face seal 16 on the peripheral edge of the visor 14 coming into contact with the rim of the helmet 11. However, in the other direction of travel the spring loaded action of the mechanism 35 causes the visor to self seal to the rim of the helmet and the face seal 16 to be pressed against the face of the user 13 to effect a tight sealing action and it is preferred that the face seal 16 is made of a foam rubber-like material, typically between 0.5 and 3mm thick and containing a radial notch or slot 45 extending approximately 80% of the width of the seal at its centre-most portion. This slot 45 has a dual function which is to provide an exit for exhalate from the breathing zone when the visor is in its operative position and, when the visor is being moved into its operative position, the slot 45 provides an enhanced degree of

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compliance of the face seal 16 in order to accommodate facial disparities between different users.

The visor 14 of Fig. 9 when in its operative position (shown in Fig.14) presents a surface extending from the helmet rim to the wearers chin which is inclined inwardly at the chin end which assists in dispersing the air flow from the fan 26 into the breathing zone without a draught of air flowing over the users face.

By way of illustration of a modification, Fig.13 illustrates a canister type of filter 25D which, of course, is fitted to a circular aperture in the outer shell of the helmet 11, whilst Fig. 14 illustrates a supply of fresh air being provided by way of a hose fitting 46 to the aperture 24 in the rear portion of the helmet 11 in substitution for a filter 25.

The respirator assemblies 10 which have been described can be manufactured with a total gross weight as low as 500 grms. Also, all of the devices required to implement a complete respiratory system are incorporated into the assembly 10 with the replaceable components (the batteries 28 and the filters 25A,25B,25C) readily accessible and replaceable from the exterior of helmet 11. The fact that the batteries and filter arrangements are located in the rear portion of the helmet 11 provides for a mechanical balance to the weight at the front of the helmet which is provided by the fan 26 and the visor 14. The filters may take any one of a number of different forms depending upon the degree of filtration required but each is readily releasable and replaceable from the exterior of the helmet 11 by way of a snap-action, toggle, clip or the like fastener. Likewise, the batteries 28 may be part of a modular pack fitted to the helmet 11 by way of a snap-action, toggle, clip or like fastener. The extent to which the filter or battery

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modules protrude from the profile of the helmet 11 will depend upon the duty of the components and their performance characteristics but for most purposes the protrusion will be minimal.

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CLAIMS

1. A respirator apparatus (10) comprising a helmet (11) having a pivotally mounted face shield (14) fitted to the front of the helmet (11) (in the wearing position), the face shield (14) carrying on its edge a flexible sealing member (16) adapted when the face shield (14) is in its lowered or operational position to seal at its lateral edges with the face of a person wearing the helmet (11), the lower edge of the sealing member (16) defining an exhalate outlet (45), wherein the helmet (11) comprises a plurality of lightweight shells (17,18) joined together to form a unitised structure incorporating a plurality of ducts (21,22,23) extending between the shells (17,18) to channel a plurality of air flows from a filtered air intake arrangement (24,25) in a rear portion of the helmet (11) to an air outlet arrangement (26,27) at the front of the helmet (11) and behind the face shield (14), air being powered through the ducts (21,22,23) by a motor driven fan (26) forming part of the air outlet arrangement (26,27) and located within the ducts (21,22,23), and batteries (28) providing a power source for the fan (26) are located within a compartment (29) formed in the rear portion of the helmet (11) and isolated from the ducts (21,22,23), the batteries (28) and air filter (25) being replaceably mounted in the rear portion of the helmet (11) and releasable exteriorly therefrom via apertures formed in the outermost shell (18) of the helmet (11).

2. Apparatus as claimed in claim 1, wherein the shells (17,18) are joined together around the rim of the helmet (11) and at strategic locations within the domed area of the helmet (11) to provide a monocoque construction.

3. Apparatus as claimed in claim 2, wherein the inner shell (17) is essentially a smooth dome shape with a

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peripheral rim, the outer shell (18) has a domed region which is profiled to define the ducts (21,22,23) and the domed region of the outer shell (18) lying outwith the ducts (21,22,23) is bonded to the smooth dome of the inner shell (17).

4. Apparatus as claimed in any preceding claim, wherein the face shield (14) is fitted to the helmet (11) via a pivot mechanism (35) which provides for a snap action of the face shield (14) either into its lowered (or operational) position or into its raised (or non-operational) position.

5. Apparatus as claimed in claim 4, wherein the pivot mechanism (35) incorporates pivot elements (38,39) which during pivotal motion of the helmet (11) are caused to translate in position to enable the face shield in its raised position to retract over the front of the helmet (11).

6. Apparatus as claimed in claim 4 or claim 5, wherein the fan (26) is energised by activation of an ON/OFF switch effected automatically by the face shield (14) in its movement between the operational and non-operational positions.

7. Apparatus as claimed in any preceding claim, wherein the face shield (14) self seals to the rim of the helmet (11) when in its operational position.

8. Apparatus as claimed in any preceding claim, wherein the rear portion of the helmet (11) is provided with three apertures (24,29) disposed in the outer shell (18) of which one aperture is centrally disposed and two apertures are laterally disposed whereby to accommodate either a single battery compartment (29) and twin air filters (25) or a single air filter (25) and twin battery

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compartments (29).

9. Apparatus as claimed in claim 8, wherein the replaceable battery and air filter components are modular to enable affixing of modules of different performance characteristics to the helmet (11).

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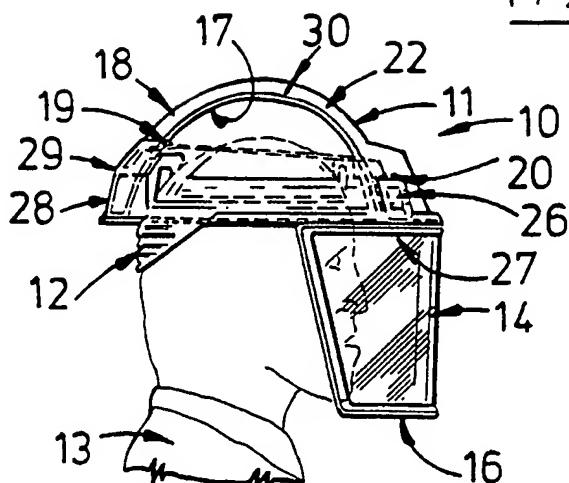


FIG. 1

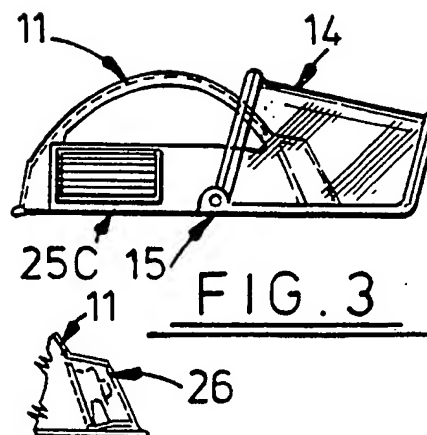


FIG. 3

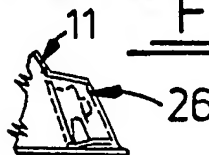


FIG. 4

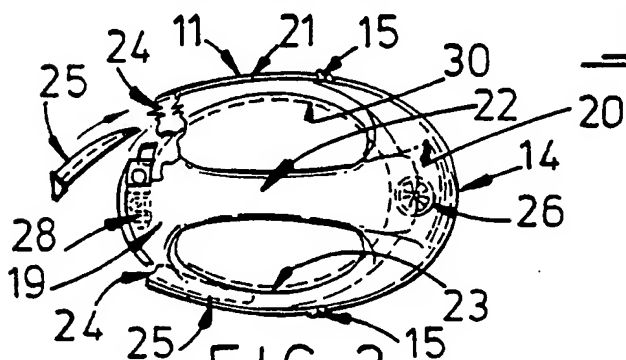


FIG. 2



FIG. 5

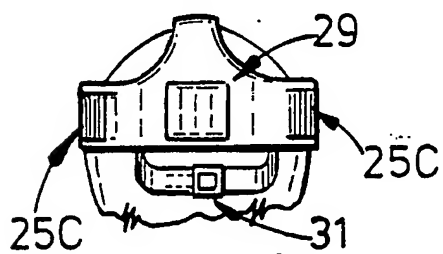


FIG. 6

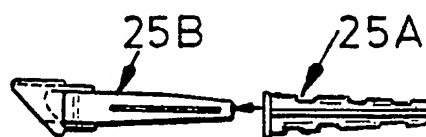


FIG. 8

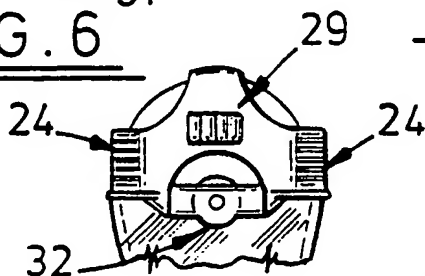


FIG. 7

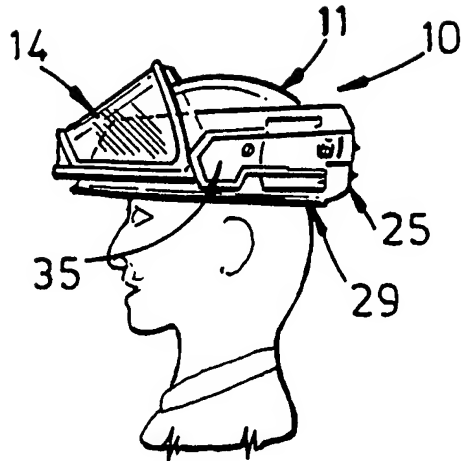


FIG. 9

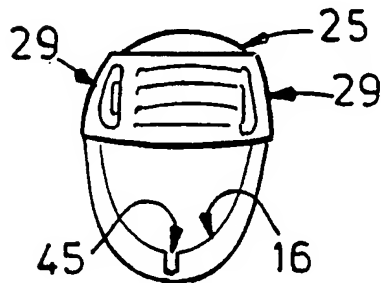


FIG. 11

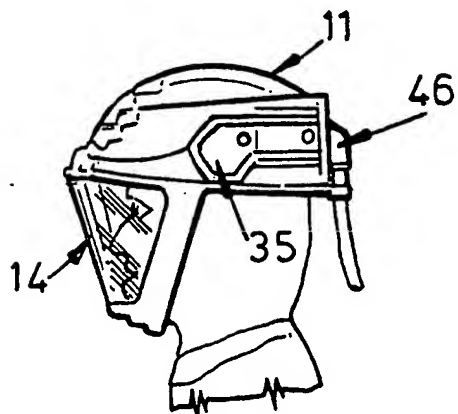


FIG. 14

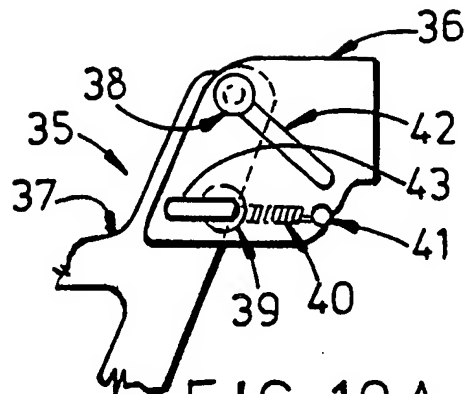


FIG. 10A

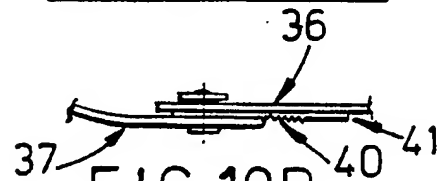


FIG. 10B

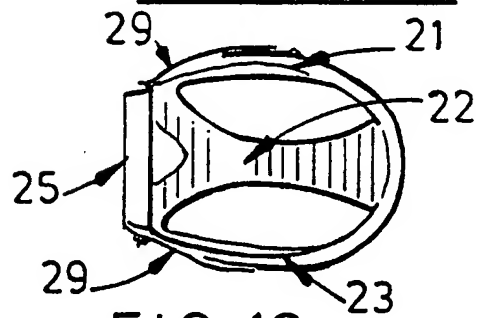


FIG. 12

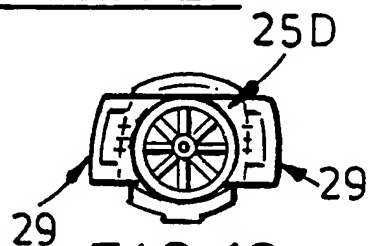


FIG. 13

INTERNATIONAL SEARCH REPORT

Inter. Application No

PCT/GB 93/01616

A. CLASSIFICATION OF SUBJECT MATTER
 IPC 5 A62B18/04 A42B3/28

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 5 A62B A42B A61F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP,A,0 492 984 (COAL INDUSTRY (PATENTS) LIMITED) 1 July 1992 see column 3, line 3 - column 4, line 44; figures 1,2 ---	1-7
A	GB,A,2 201 601 (COAL INDUSTRY (PATENTS) LIMITED) 7 September 1988 cited in the application see page 6, line 22 - page 8, line 21; figures 1-3 ---	1-4,9
A	US,A,3 413 972 (C.L.DEPPING) 3 December 1968 cited in the application see column 3, line 41 - column 5, line 22 --- -/--	1,3,4,7

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

17 November 1993

Date of mailing of the international search report

03.12.93

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
 NL - 2280 HV Rijswijk
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TRIANAPHILLOU, P

INTERNATIONAL SEARCH REPORT

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO,A,81 02514 (MINNESOTA MINING AND MANUFACTURING COMPANY) 17 September 1981 cited in the application ---	1,3
A	FR,A,2 312 979 (A.GALLET) 31 December 1976 see figures 7-9 ---	5
A	US,A,3 649 964 (W.A.E.SCHOELZ) 21 March 1972 cited in the application ---	1,6
A	DE,U,79 06 475 (HANS RÖMER GMBH) 31 May 1979 see figures 2-5 -----	8

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

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